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for reference and study. For any period the laws and regulations adopted will show the status and trend of municipal sanitary thought and practice.

Beginning with this issue, State and Territorial laws and regulations pertaining to public health will also be published in the Public Health Reports. This will make readily available to health officers and other sanitarians current State legislation and will show the measures being adopted and the progress made by the several Commonwealths. The publication of the State laws will serve the same useful purpose, as that of the city ordinances but will be of broader scope. The laws and regulations will be published as soon after enactment or promulgation as copies can be secured from the several State authorities upon whose cooperation, naturally, much will depend.

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### SMALLPOX IN THE UNITED STATES.

In this issue will be found a detailed statement of the prevalence of smallpox in 31 States and the District of Columbia during the second quarter of the current calendar year. In these States there was a total of 5,735 cases, with 53 deaths, reported during the three months, April, May, and June. Thirty-three of the deaths occurred in Texas, leaving 20 distributed among the other 30 States. In Texas there were outbreaks of the virulent form of smallpox, which accounts for the relatively large number of deaths in that State. In St. Joseph County, Ind., there appears also to have been a small outbreak of the severe type of the disease. Elsewhere the smallpox was of the benign type that has been generally prevalent throughout the country for a number of years. In the 31 States, exclusive of Texas, the average fatality rate was 1 death in 280 cases.

The presence of smallpox during the period under consideration was not limited to the 31 States referred to. The disease was also present in the other States, but there is no means of ascertaining the number of cases that occurred.

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### OUTBREAK OF GASTRO-ENTERITIS AND TYPHOID FEVER DUE TO DRINKING WATER ON EXCURSION STEAMER.

**A REPORT OF AN INVESTIGATION OF AN OUTBREAK OF GASTRO-ENTERITIS AND TYPHOID FEVER AT CLINTON, IOWA, AND OTHER TOWNS ALONG THE MISSISSIPPI RIVER AMONG EXCURSIONISTS WHO HAD BEEN ON A RIVER STEAMER JULY 29 AND 30.**

By L. L. LUMSDEN, Surgeon, United States Public Health Service.

Pursuant to bureau instructions, an investigation was made of the outbreak of gastro-intestinal disturbance (vomiting and diarrhea) and typhoid fever which occurred in July and August of this year in Clinton, Iowa, and other towns along the Mississippi River.

Dr. H. R. Sugg, health officer of Clinton, Iowa, had collected, before my arrival, extensive data about the outbreak in Clinton and had ascertained that a number of other towns were affected simultaneously with Clinton. He placed the data which he had collected

at my disposal and rendered me very material assistance in the collection of further data.

The request for the investigation was made by the health officer of Clinton and was approved by the Iowa State Board of Health. The investigation was begun on October 4 and terminated on October 11. Clinton, Lyons, Camanche, Sabula, and Davenport in Iowa; Albany, Savanna, and Quincy in Illinois, and St. Louis in Missouri were visited.

Dr. Sugg's findings furnished strong evidence that the infection responsible for the outbreak was contracted in the course of an excursion trip made on the steamer *G. W. Hill* on July 29.

From Clinton (including Lyons) about 1,200 persons went on the excursion. Of these persons the writer estimates, from the data collected by Dr. Sugg and himself, at least 600 (or 50 per cent) became ill between 12 and 72 hours after their return from the trip. The illness was manifested usually by nausea and vomiting, diarrhea, and prostration. Diarrhea was the most constant symptom. The majority of the cases had nausea and vomiting along with the diarrhea. A few had nausea and vomiting without diarrhea. A small proportion had fever during the diarrheal attack. Some had rather severe abdominal pain. In the majority of cases the duration of the gastro-intestinal disturbance was from 3 to 5 days. In some cases the attack continued for only about 24 hours and in others for several weeks. In some of the cases there were recurrences at intervals of 3 or 4 days. The symptoms presented in the attacks were similar to those which have been presented in a number of outbreaks of diarrhea (sometimes referred to as outbreaks of "winter cholera") resulting from the use of water supplies polluted with sewage. Striking examples were furnished by the outbreak in Mankato, Minn., in 1908,<sup>1</sup> and the one in Rockford, Ill., in 1912.<sup>2</sup>

Among the residents of Clinton who did not go on the excursion trip on the steamer *G. W. Hill* on July 29 there was during the summer of 1912 no unusual occurrence of diarrheal disease.

At a meeting of the Clinton County Medical Society on October 4, attended by about 30 practicing physicians, the writer asked those present about outbreaks of diarrhea in their practices during the summer. A number reported the occurrence of such outbreaks among members of families who went on the excursion, but none reported such outbreaks among members of families who did not go on the excursion.

The writer canvassed in Clinton about 50 households, some of whose members went on the excursion. The outbreak was sharply confined to those who went on the excursion. In a number of instances every member of a family who made the trip was attacked and every member of the family who did not go on the excursion was exempt.

#### THE EXCURSIONS OF JULY 29 AND 30.

From the data collected in Clinton it was clear that the outbreak was not caused by a distribution of infection in Clinton, but was caused by infection contracted from some source in the course of the

<sup>1</sup> Bracken, Bass, Wesbrook, Whittaker, and Hill: The Mankato Typhoid Fever Epidemic of 1908. *Journ. Infectious Diseases*, vol. 9, No. 3, Nov., 1911, p. 410.

<sup>2</sup> Jordan: The Rockford (Ill.) Typhoid Epidemic. *Journ. Infec. Diseases*, vol. 11, No. 1, July, 1912, p. 21.

excursion on the steamer *G. W. Hill* on July 29. Therefore the investigation was extended to determine if persons who went on the excursion from other towns along the Mississippi River also were affected. The excursion of the steamer *G. W. Hill* on July 29 was as follows: Left Lyons (now a part of the corporation of Clinton), Iowa, about 8.30 a. m.; first stop at Clinton; next at Camanche, Iowa; next at Albany, Ill.; and arrived at Davenport, Iowa, about 1 p. m.; remained at Davenport until about 4.30 p. m., and then made return trip, stopping at same towns which were stopped at on the trip down the river that morning, and arrived at Lyons about 11 p. m. This excursion was under the auspices of the First Congregational Church of Clinton. From Lyons there were about 450 passengers, from Clinton about 900, from Camanche 123, and from Albany 86—a total of about 1,550. This was an unusually large number of persons to go on the steamer at one time. The day was said to have been very warm and the demand among the passengers for ice water large.

On the following day the steamer *G. W. Hill* made an excursion trip from Sabula, Iowa, via Savanna, Ill., Bellevue, Iowa, and Sand Prairie, Ill., to Dubuque, Iowa, and return. This excursion was made under the auspices of the Presbyterian Church in Savanna. There were from Sabula 63 passengers, from Savanna about 250, from Bellevue 124, and from Sand Prairie 33. Of the passengers who went aboard at Savanna about 150 were people who lived in Savanna and the remainder came from Freeport, Shannon, Mount Carroll, and the surrounding country in Illinois. Most of those who went aboard at Sand Prairie were from Hanover, Ill.

On both of the excursions—that of July 29 and that of July 30—the bulk of the food consumed by the excursionists was furnished from lunch baskets prepared in many different homes and taken along by the members of the same family or small groups of friends for their exclusive use. Some parties took cold tea or water from their homes for use as a beverage while on the trip. On board the steamer sandwiches, ice cream, and soft drinks, such as lemonade, soda water, ginger ale, etc., were offered for sale and sold to the excursionists from stands owned and furnished by the steamship people.

While at Davenport many of the excursionists of July 29 ate and drank at different hotels, restaurants, lunch rooms, and private homes in that city; but so far as could be ascertained no large proportion ate or drank at any one place while there. On both excursions the water furnished the excursionists for drinking purposes was obtained, the steamship officials state, from the Mississippi River while the steamer was underway. Ice was placed in the water in the tanks on board and the steamship officials state that all of the ice used on board on July 29 and until Dubuque was reached on July 30 was obtained from a dealer in Lyons. That dealer states that the ice he furnished the steamer on July 29 was "pure channel ice, the same we have been supplying our customers with all season."

#### OUTBREAKS OF DIARRHEA AND TYPHOID FEVER AMONG EXCURSIONISTS.

Upon investigating the situation in all the towns from which persons went on the excursion of July 29, it was found that the excursionists who went from Camanche and Albany were affected in the same way and in about the same proportion as were those who went from Clinton and Lyons. In each of the towns persons who did not

go on the excursion were not affected, while among those who went at least 50 per cent had the diarrheal attack and some developed typhoid fever. Among the persons who went on this excursion four cases of illness terminated in death—one from the gastro-intestinal attack and three from typhoid fever. Between July 29 and September 5 there developed among the excursionists definitely diagnosed cases of typhoid fever, which were learned of in the course of the investigation, as follows:

Eight among those who went from Clinton or Lyons, two among those who went from Camanche, and one among those who went from Albany. It is quite probable that more cases of typhoid fever than were learned of by the investigators developed among the excursionists, because typhoid fever is not a reportable disease in either Iowa or Illinois. During the period from July 29 to September 5 there developed, so far as could be ascertained, among the residents of Clinton (including Lyons), with a population of about 27,000, of Camanche, with a population of about 800, and of Albany, with a population of about 800, no cases of typhoid fever other than those which developed among the persons (about 1,550 all told) who went on the excursion on July 29. Thus the 1,550 persons who went on the excursion living in widely scattered areas in three different towns furnished about 800 cases of a severe and acute diarrhea, and at least 11 cases of typhoid fever, while some 29,000 persons living in these same towns and exposed to the same general conditions in the towns as were those who went on the excursion were not affected. This fact alone shows beyond doubt that something happened on the excursion which was responsible for the sickness.

Upon investigating the situation at Sabula, it was found that the persons who went from there on the excursion to Dubuque on July 30 were affected in the same way, but in somewhat smaller proportion than were the persons in Clinton (Lyons), Camanche, and Albany, who went on the excursion on the same steamer (the *G. W. Hill*) the day before.

Of the persons who went from Subula on the Dubuque excursion about 15 had the diarrheal attack within the 72 hours following, and two developed typhoid fever within the 3 weeks following. Besides these two cases of typhoid fever there was only one other case in the town during the summer and that case was in a person who came home sick after an absence of some months in a railroad camp in Illinois. Among the residents of Sabula who did not go on the excursion there was, during the summer, no outbreak of diarrhea.

From Sabula the writer went across the river to Savanna, Ill., fully expecting to find that the persons who went on the Dubuque excursion from Savanna had been affected as had those who went from Sabula. He was surprised to find that such was not the case. The health officer, all of the practicing physicians, and a number of citizens—including the business manager of the Dubuque excursion—in Savanna were interviewed, but there was no history of an outbreak of diarrhea or typhoid fever in July or August either among the residents who did go on the excursion or among those who did not go. Upon further investigation the writer ascertained that there was no outbreak of illness among those who went on the Dubuque excursion from Bellevue, Hanover, Mount Carroll, or Freeport. From this important fact it appeared that on the morning of July 30, either when the steamer was going across the river from Sabula to Savanna, or at

some other time between the time on which some of the excursionists got aboard at Sabula and the time of the departure of the steamer from Savanna, something occurred which prevented the persons who embarked at Savanna and the subsequent ports from being exposed to the infection to which the persons who were on the vessel the day before, and to which some of the persons who embarked at Sabula that morning, were exposed.

The dates of definite onset of illness with symptoms of the cases of typhoid fever which developed among the excursionists of July 29 and 30 were as follows:

Date:	Number of cases.
Aug. 5.....	1
Aug. 10.....	1
Aug. 12.....	2
Aug. 13.....	1
Aug. 14.....	2
Aug. 17.....	1
Aug. 18.....	2
Aug. 24.....	1
Sept. 4.....	1
Sept. 5.....	1
Total.....	13

The case with onset on August 5 had a diarrheal attack beginning July 31 which continued until fever was noticed on August 5. If the definite onset of typhoid in this case was August 5 the incubation period ( seven days), presuming infection was contracted on July 29, was somewhat shorter than the average incubation period for typhoid fever.

Presuming that infection was contracted on July 29 in the cases developing definite symptoms of typhoid on September 4 and 5, the incubation period in these cases was unusually long; but in both these cases the diarrheal attack began the day after the excursion and continued for about one week. Following the diarrheal attack both cases suffered from headache, lassitude, and digestive disturbance until the definite onset of typhoid symptoms.

It is quite probable, in view of all the evidence, that in all three of the cases presenting unusual incubation periods for typhoid the infection came from the same source as that for all, or the majority, of the other 10 cases.

#### EPIDEMIOLOGICAL FINDINGS.

The writer personally interviewed in the different towns about 75 families, some members of which went on either the excursion of July 29 or that of July 30. There was a striking similarity in the histories obtained. The following histories are presented as types:

(1) Family of J. E. D. Address, Clinton, Iowa. Number in household, 7. Went on excursion, 7. Number had diarrheal attack, 7. Number drank water from tank on steamer, 7. Number ate or drank things not taken from home, 5 ate ice cream bought on steamer, 3 ate dinner at a private home in Davenport. *Remarks.*—Mr. D. and oldest daughter drank much less water on the steamer than the other members of the family did, and their diarrheal attacks were of shorter duration and milder than were those of the others. All noticed that the drinking water on steamer was decidedly turbid.

(2) Family of C. L. P. Address, Camanche, Iowa. Four in family. Two, mother and daughter, went on excursion. Both had diarrheal attacks. Others remained well. Onset of one, July 30; of other, July 31. Duration of illness, about 1 week.

Both drank water from tank on steamer. Daughter ate ice cream on steamer; except for this and water on steamer, neither ate or drank anything not taken from home. Both noticed drinking water on steamer was turbid—particularly on return trip.

(3) Family of W. H. Albany, Ill. Number in family, 5. Went on excursion, 3. Had diarrheal attack, 2 out of the 3 who went on excursion. Drank water from tank on steamer, 3. Besides water on steamer, 2 ate or drank things not taken from home. Of these 1 had diarrheal attack, other did not.

(4) Family of K. F., Albany, Ill. Four in family. All 4 went on excursion. Two had diarrheal attack. These 2 drank water on steamer, other 2 did not.

(5) Family of F. V. C., Clinton, Iowa. Six in household. Five, mother and 4 children, went on excursion. Four, mother and 3 children, had diarrheal attack. Onsets between July 30 and October 2. Duration of attacks 2 to 10 days. All 5 drank water from tank on steamer. Besides water on steamer none ate or drank anything not taken from home.

A number of persons who went on the excursion but did not drink any water on the steamer did not get sick. All who were interviewed who went on the excursion of July 29 and who afterwards had the diarrheal attack gave a history of drinking water during the return trip from the tank on the upper deck of the steamer.

So far as could be ascertained, none of the considerable number of persons who made the trip to Davenport, but not the return trip, on the steamer *G. W. Hill* had the diarrheal attack; nor did any who on the return trip did not drink water from the tank on the upper deck have the diarrheal attack.

A number of persons who went on the excursion and afterwards remained well gave a history of not drinking any water while aboard the steamer except that from a barrel near the engines on one of the lower decks. Several interviewed stated that the water in this barrel was much clearer than that furnished from the tank on the upper deck. A number of the excursionists stated that they noticed the water from the tank on the upper deck was much more turbid just as the steamer left Davenport than it was on the trip down. The steamship officials stated that the master and the crew of the steamer had rigid instructions not to pump water into the drinking-water tanks except when the vessel was in the channel, and that they had no reason to believe that their instructions were disobeyed on July 29.

A young man among the excursionists stated that about a half hour before the steamer left the beach at Davenport he was seated against the water tank on the upper deck, and certainly heard water running into the tank, and that one of the deck hands, after the tank presumably had become filled, got up on the tank and closed the valve in the pipe leading into the tank. A young lady who was seated on the top of the tank at the time stated that she remembered getting down to let the deck hand get at the valve.

While at Davenport the steamer lay at a beach landing at the foot of Brady Street, just upstream from the ferry landing. Upstream from and within 500 yards of where the steamer lay several of the city's sewers discharge into the river. The mouths of the sewers are about 30 feet out in the stream from low-water mark on the beach. Judging from where the steamer lay while at Davenport the intake for the steamer's supply of drinking water must have been within 10 or 20 feet of—perhaps immediately over—one of the sewer outlets.

The salient features in the histories of the 13 cases of typhoid fever which developed among the persons who went on the excursions of either July 29 or July 30 are presented in the table on page 1966.

## Summary of cases of typhoid fever among excursionists.

Case No.	Address.	Definite onset of typhoid.	Onset of diarrheal attack.	Number in household.	Number in household on excursion.	Number had diarrheal attack.	Drank water on steamer.	Besides water on steamer ate or drank while on excursion anything not taken from home.	Water used at home.	Source of milk used at home.	Contact with typhoid cases during 30 days prior to onset of illness.	Remarks.
1	Olney Avenue, Clinton.	Aug. 5	July 31	5	5	4	Yes	No	Clinton city supply.	Sanitary Dairy	No	One who did not have diarrheal attack. Made trip down river, but not return trip.
2	Seventh Avenue, Clinton.	Aug. 12	None	7	2	0	Yes	do	do	Clover Leaf Dairy.	No	Patient's sister who went, did not drink water on steamer.
3	Pearl Street, Clinton.	Aug. 13	July 30	7	3	3	Yes	Ice cream on steamer.	Private well	Own cow	No	
4	Stockholm Street, Clinton.	Aug. 14	do	7	2	2	Yes	do	Clinton city supply.	Sanitary Dairy	No	Sister's diarrheal attack persisted for four weeks.
5	Elm Street, Clinton.	Aug. 18	None	4	2	0	Yes	do	do	Caesar's Dairy.	No	Patient's mother ate ice cream, but drank no water on steamer, and not sick.
6	Kenilworth Court, Clinton.	do	do	5	5	2	Yes	No	do	Seymour's & Peterson's Dairies.	No	Patient died Sept. 2. Of 3 in family who drank water on steamer, 2 had diarrhea and 1 typhoid.
7	Fifth Street, Lyons, Iowa.	Aug. 24	July 30	7	6	6	Yes	Ice cream in Davenport.	do	Tigh Dairy	No	All in party except one, who later had typhoid, ate ice cream on steamer.
8	Fourth Avenue, Clinton.	Sept. 4	do	5	4	4	Yes	Ice cream on steamer.	do	Seymour's Dairy.	No	Was "droopy" after diarrheal attack of one week's duration until onset of typhoid.
9	Camanche, Iowa.	Aug. 10	July 31	9	4	2	Yes	No	Well at home.	Neighbor's cows.	No	Patient died Sept. 7. Two in party who did not get sick drank water while on steamer only from barrel in engine room.
10	do	Aug. 12	July 30	5	3	3	Yes	do	do	do	No	Died about Sept. 5.
11	Fenton, near Albany, Ill.	Sept. 5	do	8	6	5	Yes	(?)	do	do	No	Member of party who did not get sick drank no water on steamer.
12	Sabula, Iowa.	Aug. 14	Aug. 1	6	4	4	Yes	Ice cream on steamer.	Sabula supply	Sabula dairies.	No	Went on excursion from Sabula to Dubuque on July 30.
13	do	Aug. 17	July 31	3	1	1	Yes	No	do	do	No	Do.



The ages of the persons among whom the 13 cases of recognized and reported typhoid fever occurred were as follows:

	Number of cases.
5 to 9 years.....	2
10 to 14 years.....	3
15 to 19 years.....	2
20 to 24 years.....	3
25 to 29 years.....	1
40 to 49 years.....	2
Total.....	13

Besides the 13 frank cases of typhoid which developed among those who went on the excursions, there were 8 or 10 cases reported by physicians as suspected cases, but which were not positively diagnosed.

#### POSSIBLE SOURCES OF THE INFECTION.

At the beginning of the investigation the first fact to be determined was whether the infection in Clinton had been of local distribution in Clinton or was contracted in the course of the excursion. The freedom of the residents who did not go on the excursion from the outbreaks of illness and the synchronous occurrence of outbreaks of identical nature among persons who had not been in Clinton, but who went from other towns on the same excursion, and the freedom from attack of the residents of the other towns who did not go on the excursion showed definitely that the infection must have been contracted in the course of the excursion. The next question was whether the infection had resulted from some condition on board the steamer or from some condition to which the excursionists were exposed while ashore in Davenport.

Upon investigation it was found that among a population of about 48,000 in Davenport there had been in the period from July 29 to September 5 no outbreak of either diarrhea or typhoid fever. According to information received from the local health department there were only about 12 cases and no deaths reported from typhoid fever in Davenport during the two months of August and September. The only possible source of infection which was common to any large proportion of the excursionists while they were in Davenport was the city water supply. Had this been the source of the infection for the excursionists the Davenport people necessarily would have been affected. Furthermore, no condition in respect to foods and beverages to which the excursionists were exposed while ashore in Davenport on July 29 could have affected the Sabula people who went on the Dubuque excursion on July 30.

From these facts and all other facts definitely established by the investigation there was left no room for doubt that the condition responsible for the infection was on board the steamer; that this condition became operative at some time between the arrival of the steamer at Davenport and the arrival at Albany, on the return trip, on the afternoon of July 29; that it was still operative when some of the passengers went aboard at Sabula on the morning of July 30 for the Dubuque excursion, but ceased to be operative before the steamer left Savanna on the morning of July 30.

Some of the passengers who went aboard at Sabula remembered drinking water aboard the steamer on the morning of July 30 while the steamer was either at the landing there or on the way across the river to Savanna. Others could not remember positively whether they drank any water on the steamer before the departure from Savanna.

One history obtained at Sabula was for a time misleading and emphasizes the need of giving careful consideration to the possibilities of coincidence in the course of such epidemiological investigations. This history was that of a young man who joined the excursion party on the return trip from Dubuque on July 30. He went aboard at Bellevue and made the trip only from there to Sabula via Savanna. He became ill with fever on July 31. His illness continued for about 2 weeks, and in the course of the attack he had some vomiting and purging. His clinical history was quite similar to the histories in a small proportion of the cases which developed among the persons who went on the excursion of July 29. In view of all the findings subsequent to the visit of the writer to Sabula, it is highly probable that the illness of this young man was caused by infection having a source different from that which caused the outbreaks among the Sabula people who made the excursion trip from Sabula to Dubuque on the morning of July 30, and among the excursionists from Lyons, Clinton, Camanche, and Albany, on July 29. Among the conditions on board the steamer to be considered as possibly responsible for infection which had caused such outbreaks were those associated with the following:

- (1) The foods and beverages taken aboard the steamer by the excursionists.

- (2) The foods and beverages—sandwiches, ice cream, and soft drinks—sold to the excursionists on the steamer.

- (3) The drinking water supply (including the ice used in the tanks) furnished the excursionists while they were on the steamer.

The lunch baskets containing the foods and beverages taken aboard by the excursionists came from many different homes, and only a small group of persons was exposed to any possible infection which might have been contained in the foods or beverages in any one of the lunch baskets. So far as could be ascertained there was between the many different groups very little interchange of contents of lunch baskets, and certainly not enough to cause any considerable proportion of the excursionists to be exposed to the contents of any one or several lunch baskets. Besides, the excursionists from Sabula on July 30 could not have eaten from the lunch baskets used by the excursionists of July 29.

Of the cases of illness which developed among the persons who went on one or the other of the excursions a large proportion was in those who ate or drank nothing while on the excursion except water aboard the steamer and foods taken from their own homes. Some of the soft drinks sold aboard the steamer were said to have been made in part with water taken from the tanks on the steamer. The summary on page 1966 shows that of the 13 cases of typhoid 5 were in persons who ate ice cream bought on the steamer. Seven of the cases gave a definite history of not having eaten ice cream bought on the steamer; so that, obviously, the ice cream sold on the steamer could not have been the source of the infection for the majority of the cases. Many of the excursionists who subsequently had the

diarrheal attack gave definite histories of not having eaten or drunk while on the steamer anything except the drinking water on board and things taken from their homes. According to information received from the steamship company the ice cream sold aboard the steamer on July 29 and until the steamer reached Dubuque on July 30 was obtained from one dealer in one shipment.

Therefore the excursionists who went from Savanna, Bellevue, and Sand Prairie on the upriver trip to Dubuque, and who ate ice cream bought on the steamer, were furnished from the same lot of ice cream furnished the excursionists of July 29 and the excursionists from Sabula on the morning of July 30.

Ice was used in the drinking-water tank on the steamer from which all of the excursionists who subsequently were attacked drank water, and, therefore, all of the cases of illness in the outbreaks were in persons who had been exposed to whatever infection may have been in the ice.

On general epidemiological principles, it is highly improbable that natural ice harvested from the Mississippi River and stored for 5 or 6 months would contain infection in sufficient dosage to cause among persons who drank water cooled with the ice an outbreak of such severity and extent as that which developed among the persons who went on the excursion of the steamer *G. W. Hill* on July 29. It should be remarked, however, that much of the ice harvested from the Mississippi River, often, it appears, without due regard being given to the proximity of the ice field to sewer outlets, must be regarded as being of somewhat doubtful purity.

According to information received from the steamship company and from the ice dealer concerned the ice used in the water tanks on the steamer on July 29 was natural ice harvested from the river the winter before. The vast bulk of the batch of ice of which that furnished the steamer was a part was distributed among many different consumers in Lyons and Clinton, who were not affected by any extensive outbreak of illness.

The same lot of ice furnished the steamer by a dealer in Lyons, on July 29 was used in the water tanks the whole of that day and until the steamer reached Dubuque on July 30. Therefore, the excursionists from Savanna, Bellevue, and Sand Prairie on July 30 drank water cooled with ice from the same lot—if not the same pieces—as that used to cool the water drunk by the excursionists of July 29.

In view of all the facts it is possible that the ice, the ice cream and other foods used on the steamer may have contributed to the infection responsible for the outbreaks, but it seems certain that they could not have been either the sole or the principal source of the infection. Every circumstance pointed to the drinking water furnished from the tank on the upper deck of the steamer as the principal or sole immediate source of the infection.

#### THE WATER SUPPLY.

In a letter to the writer from the owners of the steamer *G. W. Hill*, dated October 10, 1912, is the following statement:

The drinking water furnished on the steamer *G. W. Hill* during the months of July and August was pumped from the Mississippi River while in the channel, and never close to any town, through a stone filter which rendered the water perfectly clear, and guaranteed by the St. Louis Filter Co. to be perfectly pure. The water furnished on July 29 and 30 was supplied in the same manner.

According to statements obtained by the writer from over a hundred persons who were on the excursion of July 29 or that of July 30, the water obtained from the tank on the upper deck of the steamer was decidedly turbid, and particularly so on the return trip from Davenport on July 29. If the water at that time was not "perfectly clear," it is quite probable that it was not "perfectly pure."

According to information received from two of the excursionists, water was pumped into the tank on the upper deck while the vessel was at the landing at Davenport.

The capacity of the drinking-water tank from which the passengers were supplied was about 150 gallons. To supply the 1,550 passengers on board on a warm day the tank must have been filled four or five times during the excursion of July 29. Considering the sewage pollution of the river, the writer does not regard any place in the river between Clinton and Davenport as a safe source of water for drinking. During the stay of three hours at Davenport it is probable that there was most of the time a scattering of passengers on the steamer, and when, just before leaving, all the passengers came aboard, many of them thirsty, there must have been a heavy drain on the drinking-water supply. So far as could be ascertained from statements of all the passengers interviewed, there was at no time a shortage of water in the tank, the taps on the pipes leading from the tank when opened always yielded water, and particularly turbid water at the time of the departure from Davenport. Some of the passengers stated that the water contained trash and small sticks. It was stated by the steamship company that none of the crew, consisting of about 40 men, were attacked with either diarrhea or typhoid in the 5 or 6 weeks following the excursion of July 29.

Some of the passengers, who stated that they drank water from the barrel near the engines but none from the tank on the upper deck, did not get sick. It is probable that most of the water used by the crew was taken from the barrel. Furthermore, not every passenger who drank water from the tank got sick. Several weeks prior to the time of this investigation the steamer had gone out of commission and the crew was not interviewed. The writer, accompanied by the general manager of the line, made an inspection of the steamer on October 11. The steamer was then at Quincy, Ill., laid up for repairs.

So far as the writer could make out, the arrangement of the pipes was such that water could not be pumped into the tank on the upper deck without being passed through a stone filter. He was informed that the pressure—usually from 20 to 30 pounds—employed to pump the water from the intake at the bottom of the steamer, forced the water through the filter and then up into the tank on the upper deck, about 25 feet above the intake. It is highly improbable that water filtered so rapidly and under such pressure would be efficiently filtered. From all points in the evidence collected it is clear that if the water which was pumped to the tank, while the steamer was at Davenport or sometime shortly after leaving Davenport on July 29, was filtered, it was not efficiently filtered.

While at St. Louis on October 10, the writer looked into the matter of water supplies used on steamers generally—both excursion steamers and packets—plying between St. Louis and St. Paul and between intermediate points along the river. He found that the general custom for these steamers is to take water for drinking purposes from

the Mississippi River. On most of the vessels the water is run through some device on board designated as a filter. Such filters, as they are, and operated, as they usually must be, are necessarily of low efficiency. While aboard one passenger vessel at a wharf in St. Louis in the immediate neighborhood of sewer outlets the writer was given a demonstration of the filtration of the water supply for that steamer. Especial pains apparently were taken in making the demonstration, but in spite of the pains the water persisted in being muddier after it had been passed through the filter than it was before. Evidently the mud collected in the filter was being washed through.

In view of the conditions associated with the water supplies furnished on steamers plying on the upper Mississippi River it is not surprising that an extensive outbreak of sickness caused by water-borne infection did develop among the passengers on one of these vessels, viz, the steamer *G. W. Hill*, but it is surprising that such outbreaks have not occurred on numerous occasions.

#### CONCLUSIONS.

1. The outbreaks of diarrhea and typhoid fever which occurred among the persons who went on one of the excursion trips made by the steamer *G. W. Hill* on July 29 and July 30, 1912, were caused, beyond reasonable doubt, by infection in the drinking water supplied aboard the steamer.

2. The infected water was pumped into the tank on July 29 while the vessel was either at the landing at Davenport or at some point in the river between Davenport, Iowa, and Albany, Ill.

3. The bulk of the evidence strongly suggests that the infected water was pumped into the drinking-water tank while the steamer was at the landing and a short while before leaving Davenport on July 29.

4. The water supplies used generally on the steamers plying on the Mississippi River along its course between St. Louis and St. Paul are potentially dangerous and the methods of obtaining such water supplies should be corrected and conducted under official supervision.

#### RECOMMENDATIONS.

1. That water supplies used on river steamers and sanitary conditions generally pertaining to such steamers be made subject to adequate official inspection, the vessels plying between ports in different States to be inspected from time to time by officers of the United States Public Health Service and those plying between ports in the same State to be inspected from time to time by State or municipal health officers.

2. That all steamers plying on the Mississippi River be required to furnish water for drinking purposes for persons on board which will be demonstrably free from potential danger.

3. That steamers take their water supplies from sources—such as city or town water supplies along the river—certified as being safe by National or State health officials.